

# EDTA: Its Influence on the Bioavailability of Metals in the Body and in the Environment

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## Summary of Results

Ethylenediaminetetraacetic acid (EDTA) is a common metal chelating agent used in a multitude of industrial and household applications, where removal of heavy metals is desired. Among the many applications of EDTA are its use in detergents and in food processing. There is growing concern that, due to the environmental persistence and hydrophilicity of EDTA, its increasing concentrations in the environment may increase the bioavailability of heavy metals that are sequestered in lake and river sediments. We studied the release of soil-bound heavy metals from contaminated sediment collected from 39 meters depth at Lake Couer d'Alene, ID by exposure to EDTA. Lake Couer d'Alene was chosen due to its history of being downstream from major mining activity for decades, and having bottom sediment that has been contaminated with heavy metals.

The first series of experiments involved placing 6.6 g of oven-dried soil samples in a flask, and adding either lake water, or lake water and 0.5 g of EDTA to the flask. Final volumes were 100 mL. A blank sample without sediment was also prepared. The pH was measured at 5.0 – 5.5. The flasks were allowed to equilibrate for 48 hours. The samples were then vacuum-filtered, and the filtrate was analyzed by atomic absorption spectroscopy (AAS) for the presence of arsenic, cadmium, lead, and zinc. The results are summarized in Table 1 below:

**Table 1. Heavy metal concentrations in EDTA exposure experiments**

	As <sup>3+</sup>	Cd <sup>2+</sup>	Pb <sup>2+</sup>	Zn <sup>2+</sup>
<b>Water + EDTA</b>	N.D.	0.397 ppm	N.D.	0.443 ppm
<b>Water + Sediment</b>	N.D.	0.473 ppm	N.D.	1.36 ppm
<b>Water + Sediment + EDTA</b>	N.D.	0.715 ppm	66ppm	3.34 ppm

N.D. = Not Detected

As can be seen from Table 1, the levels of cadmium, lead, and zinc in the filtrate increased significantly when EDTA was added to the samples. This is strong evidence that EDTA is capable of chelating these metals and releasing them from these soils. It is interesting to note that EDTA did not appear to increase arsenic levels in the filtrate. More work is required to determine the cause of this seemingly anomalous result.

Additional samples were prepared with variations in EDTA concentration, and pH. However, instrumental difficulties with our AA spectrophotometer did not allow the analysis of these samples. Currently, the AA appears to be back on-line, and we anticipate the analysis of these samples soon.

### **Future Work/Ongoing Efforts.**

Future work includes the analysis of samples that were prepared in order to determine the effects of pH and EDTA concentration on the bioavailability of soil-bound heavy metals. A time series experiment is also planned in order to determine the kinetics of the reactions between EDTA and the soil-bound metals. Work is also planned to determine the concentrations of EDTA in the metal-contaminated watershed, both in Lake Couer d'Alene, and downstream from Spokane, WA, where EDTA is expected to be present.

In addition, work will begin in Fall 2006 to determine the binding constants for various heavy metals with DMSA (meso 2, 3 dimercaptosuccinic acid) and with EDTA in blood. DMSA is a chelating agent that is used to treat lead poisoning.

### **Expectations for Dissemination**

There is increasing attention being paid to EDTA and its effects on bioavailability of metals, and several review articles on the subject have expressed the need for more experimental data of the nature that we are producing. I expect to publish these results in a peer-reviewed journal at some point in the future. This will require the completion of the experiments described under *Future Work*.